STANDARD OPERATING PROCEDURE 5.12 FOR COLLECTION OF SOIL SAMPLES FOR LABORATORY ANALYSIS USING INCREMENTAL SAMPLING METHODOLOGY

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis using incremental sampling methodology (ISM). This SOP describes the procedure and equipment needed to collect soil samples prior to ISM laboratory analysis. This SOP is largely based on the ITRC February 2012 technical and regulatory guidance document titled "*Incremental Sampling Methodology.*"

2.0 CONSIDERATIONS

Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation. Variability in measured contaminant concentrations between discrete soil samples is due primarily to the particulate nature of soil and heterogeneity in the distribution of contaminants. The elements of ISM that control data variability are incorporated into (a) the field collection of soil samples and (b) laboratory processing procedures. ISM is designed to obtain a single aliquot for analysis that has all constituents in the same proportion as an explicitly defined volume of soil. Properly executed, the methodology provides reasonably unbiased, reproducible estimates of the mean concentration of analytes in the specified volume of soil.

ISM should be applied within a systematic planning framework. One of the first steps in such a framework is to have the investigation project team establish a working conceptual site model (CSM). Once the CSM has been agreed to, the project team defines the data quality objectives (DQOs) and determines the appropriate decision unit (DU) size(s) and location(s). DUs are based on project-specific needs and site-specific DQOs; both considerations specify and constrain the appropriate end use of the data. The size of a DU is site-specific and represents the smallest volume of soil about which a decision is to be made. The requirement to explicitly and appropriately define the DU that each incremental sample represents is a key component of ISM and is discussed in detail throughout this SOP.

3.0 EQUIPMENT AND MATERIALS

a. Safety first. Obtain the appropriate Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

b. A work plan which outlines soil sampling requirements including the site-specific DQOs and an explanation of the gridded area to be sampled using ISM.

c. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

d. Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, plastic sheeting, etc.).

e. Sampling device (Geoprobe, split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

f. Stainless steel spoons or spatulas.

g. Disposable Nitrile sampling gloves and cut-proof gloves.

h. Laboratory-supplied sample containers with labels.

i. Cooler with blue or wet ice.

j. Plastic sheeting.

k. Black pen and indelible marker.

l. Zip-lock bags and packing material.

m. Tape measure.

n. Paper towels or clean rags.

o. Masking and packing tape.

p. Overnight (express) mail forms or schedule courier pickup.

5.0 PROCEDURE

5.1 Determine the appropriate spatial extent of the decision unit (DU) that ensures total sample mass is sufficient to represent the heterogeneity of soil particles within the DU in proportion to all of the DU soil (i.e., population). Different types of objectives may dictate the dimensions of DUs. For example, the identification and investigation of small source-area DUs may be especially important for highly mobile chemicals that can pose significant vapor intrusion or leaching risks. In other situations, larger exposure-area DUs is appropriate to evaluate risks to specified receptors. The approach selected should be consistent with the understanding of the site reflected in the CSM and should support the objectives of the investigation.

Exposure areas for residential use can vary in size depending on the location of the site and local regulatory requirements. Consideration of lot-size exposure areas is generally adequate to evaluate long-term, chronic health risks. When *exposure* can be assumed to be relatively consistent across the lot, it is not necessary to investigate concentration trends at a property below the scale of the residential lot.

Exposure areas for commercial or industrial properties are site specific and could be an acre or more in size. Certain maintenance or construction activities at these types of properties may influence the depth of the exposure area. Designation of exposure areas for these sites should be discussed ahead of time with the project risk assessor and should be based on areas of the site where exposure is likely to occur.

5.2 Determine the appropriate vertical extent of the DU. The depth (how far below ground) and interval (vertical dimension of the DU) of each DU must be carefully considered during planning stages. These attributes should be based on the project objectives and the CSM and should not be left to haphazard decisions in the field. It is important to remember that a correctly defined DU includes the requirement that all hypothetical increments within the DU have an equal likelihood of being sampled (e.g., a DU should not be defined to be 5 feet deep when only the first few centimeters are available to the sampling device).

5.3 Determine the sampling pattern strategy.

Systematic random sampling within grids – the DU is divided in a grid pattern, a random sampling location is identified within the first grid cell, and then samples (increments) are obtained from adjacent cells sequentially in a serpentine pattern using the same relative location within each cell.

Random sampling within grids - samples are obtained sequentially from adjacent grid cells, but the location of the sample within each cell is random.

Simple random sampling within the entire DU - the samples are taken from random locations across the DU (without gridding).

While all three sampling options are statistically defensible, collecting increments within the DU using simple random sampling is most likely to generate an unbiased estimate of the mean and variance according to statistical theory. Note that "random" does not mean wherever the sampling team feels like taking a sample: a formal approach to determining the random sample locations must be used.

5.4 Determine the ISM Field Sampling Implementation Method

Select the tool: The selection of the appropriate sampling tool for an ISM sample depends on the cohesiveness and composition of the soil substrate. The sampling tool, such as a direct-push Geoprobe®, should obtain cylindrical or core-shaped increments of a constant depth from the presented surface. The diameter of the sampling tool should be a minimum of three times the diameter (d) of the largest particle present in a coarse matrix ($d \geq 3$ mm), and 3d + 10 mm for a fine material. Caution should be taken to select tools that equally retain all of the particles over the entire depth of interest. In general, sampling tools should have a diameter of at least 16 mm. For less cohesive soils, attempts should be made to retain the entire, complete core increment.

Sampling devices can be used within a DU without decontamination but should be decontaminated or disposed of between DUs. If sampling tools will be used for two or more DUs, they should be cleaned of soil particles, decontaminated with the appropriate solutions or solvents, and dried between DUs. Typically, rinse (decontamination) blanks can be used to evaluate the potential effects of cross contamination, if needed.

For deeper ISM soil samples, a drilling method may be required to collect soil samples. Direct push methods are preferred (e.g., Geoprobe) for ease of sampling and cost.

<u>Determine the number of soil increments:</u>
In general, a minimum of 30 increments is sufficient for most DUs. The number of increments to be collected from each DU of a site investigation should be evaluated during systematic planning as part of the DQO process and documented in the sampling and analysis plan (SAP).

5.5 Establish DU Boundaries in the field. Depending on the size of the DU and terrain features, placement of markers (e.g., pin flags and posts) at the corners and or edges can assist with a visual delineation of the cells or subareas where increments are to be collected. That is, the markers can define lanes, grids, or collection points.

5.6 Locate each sample increment location within the DU utilizing field maps and/or the GPS. If the precise GPS location is not accessible or obstructed, move the point to the closest accessible location without regard to direction. The distance and direction moved should be noted on the field data sheet for the DU. At each location, the soil core will be collected using the approved sampling device. The soil core should be opened and observed for any evidence of visual contamination and/or unique circumstances. Any such observations should be noted. Soil with grain size greater than approximately 0.5 inches should be removed from the core. Soil should be collected using the "wedge" approach as described in the ITRC guidance. A wedge of soil must be taken from the entire length of the targeted depth interval. Target intervals to be collected will be pre-determined during the planning process. Removing a wedge of soil across the length of a larger core to encompass the entire depth interval rather than collecting the entire core depth interval as a whole, constitutes the mass of an individual increment of an ISM sample. Individual wedges, approximately 1 ounce each, from 30 or more separate DU cores are then collected to form the complete subsurface ISM bulk sample.

5.7 Place the sample in a Zip-lock bag or a laboratory-supplied, pre-cleaned sample container. Cut-proof gloves should be worn at all times when handling glassware. The samples (approximately 1 kilogram bulk samples, comprised of aliquots from each DU) will be shipped to the laboratory where the samples will be pre-processed and prepared in accordance with the laboratory SOP for ISM samples, as described below.

5.8 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials. The sample should be placed in a cooler and stored with ice, at 4°C. Store the sample cooler in a secure location.

5.9 If required by the SAP, use the remaining portion of soil to log the sample in detail and record physical characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.). Refer to Soil Classification and logging SOP.

5.10 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a Zip-lock bag to the laboratory. A signed and dated custody seal is placed on the cooler prior to shipment.

5.11 Samples collected from Monday to Friday are typically to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.12 Samples pending analysis must be handled and processed in accordance with the laboratory specific SOPs for processing incremental soil samples. Laboratory SOPs should be available in the project file.

5.13 The field notebook and appropriate forms should include, but not be limited to, the following: client name, site location, sample DU designation, sample identification, sample date and time collected, sampler's name, and method of sample collection.

5.14 All reusable sampling equipment must be thoroughly cleaned in accordance with the ROUX SOP 9.1 decontamination procedures. Discard any gloves, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE